OUR BOOKSHELF.

The Inter-Relationships of the Bryophyta. By Dr. Frank Cavers. Reprinted from the *New Phytologist.* Pp. vi+203. Cambridge: At the Botany School, 1911. Price 4*s.*; postage 4*d.*

WE are a little late in announcing that Dr. F. Cavers's series of articles which appeared on the inter-relationships of the Bryophyta in the *New Phytologist,* vols. ix. and x., 1910–11, has been issued separately. It is a great convenience to have the work in this form, and it certainly deserves this distinction. The classification is mainly that adopted in Engler and Prantl's "Natürlichen Pflanzenfamilien," but as a result of his investigations the author introduces some modifications. His proposed divisions are: (1) Sphærocarpales, (2) Marchantiales, (3) Jungermanniales, (4) Anthocerotales, (5) Sphagnales, (6) Andreæales, (7) Tetraphidales, (8) Polytrichales, (9) Buxbaumiales, and (10) Eu-Bryales.

Dr. Cavers discusses more particularly the question of the old primary division of the Bryophyta into two classes, Hepaticæ and Musci, especially in relation to the Anthocerotales and the Sphagnales. He argues: "If the Anthocerotales are to be made a separate class apart from the Hepaticæ, either Sphagnales should also be considered a separate class apart from the Musci, thus making four primary divisions of Bryophyta—Hepaticæ proper, Anthocerotes, Sphagna, and Musci proper—or the Anthocerotales and Sphagnales might be united to form a class between the Eu-Hepaticæ and the Eu-Musci, thus giving three classes of Bryophyta." But he prefers dividing the Bryophyta into ten groups as designated above.

The account of *Riella capensis* is of special interest, and it is to be followed by a more detailed paper on the genus generally. Until 1902 this singular aquatic genus was only known to inhabit the Mediterranean region and the Lake of Geneva. Since then a species has been discovered in the Grand Canary; another in Texas; a third in Turkestan; and a fourth in South Africa.

LETTERS TO THE EDITOR.

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Determination of the Epicentre of an Earthquake.

IT has been proved by observation with the Galitzin seismographs, both at Pulkowa and Eskdalemuir, that when the first phase P of an earthquake is sharp, the azimuth of the epicentre from the station is uniquely determined by the observations at that station. It follows that if the azimuth of the epicentre is determined at two independent stations suitably situated, the epicentre can be determined from these two azimuths alone.

We have to-day, as an example, verified by construction and by computation that this principle gives accurately the epicentre of the earthquake that occurred in Monastir on February 18, 1911.

The azimuth observed at Pulkowa was 22° 53′ west of south, while the azimuth observed at Eskdalemuir was 55° 56′ east of south. The resulting epicentre we find to be 40·5° N., 20·3° E.

The epicentre deduced by the Pulkowa observations of azimuth and epicentral distance was 40·5° N., 20·1° E.; while the similar deduction from the Eskdalemuir results was 40·3° N., 20·4° E.

It is clear that in this case the accuracy of determination from the azimuths alone equals that of the determinations from the separate stations, and it is known that the earthquake did occur in the region indicated.

The advantages of this new method based on azimuths alone are:—

(1) That it is quite independent of any time reckoning whatever at the two stations.

(2) That it is independent of the determination of the second phase S on a seismogram (which is frequently difficult to fix with certainty).

(3) That it is independent of any empirical tables for epicentral distance, which are admittedly only approximate.

(4) Although only two stations are used, the determination is unique.

We may observe that for a given case the accuracy of determination depends on a suitable choice of the two stations.

B. GALITZIN.
GEORGE W. WALKER.

The Observatory, Eskdalemuir, Langholm,
Dumfriesshire, August 29.

Implements of Man in the Chalky Boulder Clay.

IN NATURE of August 15 Mr. Reid Moir has given us certain interesting facts observed by him in connection with the scratching of flints.

(1) He notes the occasional scratching of what remains of the "cortex" of the original nodule. It does not seem to have occurred to him that such a result may have been produced while the flint was still enclosed in its original chalk matrix. Topley (in his "Geology of the Weald") showed long ago that the chalk strata had in many cases undergone considerable differential movement concomitant with crustal movements; and I have myself seen crushed flints still *in situ* in the chalk cliffs at Ventnor, where there is evidence of intense crustal movement of the strata. So far back as 1880 I noted this, also the extremely fractured and unworn condition of the flints left as a residuum from the solution of the chalk by carbonated rain-water on the top of St. Boniface Downs (see P.G.A., vol. viii., No. 3), and my interpretation of the phenomena there observable has since been confirmed by Dr. A. Strahan, F.R.S., of the Geological Survey. Here we have a sufficient mechanical cause totally independent of anything that may be connoted by the term "glaciation." There seemed, moreover, to be just that slight amount of surface-staining of the fractured surfaces which might be due to meteoric iron-dust.

(2) One fails to see that there is any mystery about the non-striated condition generally of the fracture-surfaces of the flint fragments from the Boulder Clay. How could the soft matrix of the Boulder Clay scratch a flint, or even hold a harder stone with sufficient grip to give it effect as a graving-tool, however great the volume-pressure may have been? When the "glazier" wants to cut glass he does not use putty to hold his "diamond." So much for the talk of "intense glaciation" of hypothetical pre-Crag flints, on which I hope to have shortly more to say.

On the other hand, boulders of the Chalk itself, if

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at all rounded by the shearing movement of the ice in which they were once embedded, are often scratched and grooved. (See further my paper on the mechanics of glaciers, Q.J.G.S., February, 1883; also NATURE, June 20, 1912.)

I can assure Mr. Reid Moir that the delicate and interesting subject of *patination* presents difficulties to those who (in microscopic and laboratory work) have brought some knowledge of physics and chemistry to bear on the *lithology of the flint,* and that it is not to be dismissed in the easy way he seems to suppose. Nor do I think that even Dr. Sturge (Proc. Prehis. Soc. of E. Anglia) has adequately dealt with the subject or with the possible causes of some phases of "striation." A. IRVING.

Bishop's Stortford, August 22.

THE FIFTH INTERNATIONAL CONGRESS OF MATHEMATICIANS AT CAMBRIDGE.

THE first Mathematical Congress was held at Zurich in 1897, the second at Paris in 1900, the third at Heidelberg in 1904, and the fourth at Rome in 1908. This year's congress met at Cambridge, August 21–28, under the presidency of Sir G. H. Darwin, and was divided into sections as follows:—I, Analysis; II, Geometry; III (*a*), Physical Mathematics; III (*b*), Statistics; IV (*a*), Philosophy and History; IV (*b*), Didactics. Several meetings of the last section were held in connection with the International Commission on the Teaching of Mathematics, which was formed by a resolution of the fourth congress to study and report on the actual state of mathematical teaching in various countries.

Receptions were given by the Chancellor, Lord Rayleigh, in the Fitzwilliam Museum, by Sir G. H. Darwin in St. John's and Christ's Colleges, and by the Master and Fellows of Trinity College. Visits were made to the University observatory and to the works of the Cambridge Scientific Instrument Company. Excursions were arranged to Ely Cathedral, Oxford and Hatfield House. Throughout the week the University and colleges displayed their customary hospitality to the full, and the appreciation of the visitors, both English and foreign, was very evident. The members numbered 572, as compared with 535 at the fourth congress, and included representatives from Brazil, Chile, Egypt, India, Japan, and Mexico. An exhibition organised by the Mathematical Association was arranged in the Cavendish Laboratory, and included English and foreign text-books, examples of school work, models and apparatus, and a most interesting and complete collection of calculating machines. Eight lectures were delivered to the whole congress, and we mention below a few of the less technical points occurring in these, and in the meetings of the didactic section.

Sir G. H. Darwin (Cambridge), in welcoming the congress at the first meeting, referred to the death of Henri Poincaré, whom he described as the one man who alone of all mathematicians might have occupied the position of president of the congress without misgivings as to his fitness. It brought vividly home to him how great a man Poincaré was, when he reflected that, to one incompetent to appreciate fully one half of his work, he yet appeared as a star of the first magnitude.

Prof. E. W. Brown (Yale) lectured on "Periodicity in the Solar System." Newton and his contemporaries aimed at obtaining functions which should express the positions of individual bodies at all epochs. This is now recognised as unattainable; and the position within certain limits of time is expressed by infinite series of terms, some of which are harmonic representing periodic motions, and others expressed as powers of the time representing secular motions. These series are carried to a degree of accuracy exceeding that of the most delicate observation; so that where the calculated positions differ from those observed by a quantity exceeding the possible error of observation, it may be safely assumed that forces are in action other than those postulated in the theory. This is notably the case in the theory of the moon, where the outstanding discrepancy is comparable with the largest of the perturbations due to the planets. Dynamical theory in the case of the asteroids has shown that in the particular case of the problem of four bodies when the mass of one is small, the motion of the latter is unstable for certain ranges of value of the radius vector; and no asteroids have, in fact, been found within these limits. It is possible that an explanation may here be foreshadowed of the dark intervals in Saturn's rings.

Prince B. Galitzin (St. Petersburg) lectured on "The Principles of Instrumental Seismology." The usual seismographic record shows three chief groups of disturbances, due respectively to the longitudinal and transverse waves through the core of the earth, and to the superficial wave round the crust. These, however, are complicated and supplemented by reflections of the deep waves at the surface, and sometimes also by twin earthquakes caused by the primary. The relations between the elastic constants of the core deduced from seismographic observations are in fair agreement with the theory of elasticity of an isotropic medium. But an attempt has been made to construct a more general theory assuming heterogeneity depending on depth. The ideal aim of seismometry must be the determination of the six components of motion of a particle of the earth's crust throughout the whole of a disturbance. Hitherto attention has been confined to the three components of translation. The practical problem of recording the three components of rotation seems to have been solved recently in an apparatus in which induced currents from two pendulums are passed simultaneously in opposite directions through the same galvanometer. There is even reason to believe that the problem of predicting earthquakes is not so hopeless as it would *a priori* seem to be.

Sir W. H. White lectured on "The Place of Mathematics in Engineering Practice." It is matter for surprise that many of the great engineering discoveries of the last century were made by men who had little or no mathematical or

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